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## Social organization in virtual settings depends on proximity to human visual aspect

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## ABSTRACT

Virtual environments are inherently social spaces, in which humans interact through avatars. However, the parameters which favor inter-individual social structuring in those settings are still far to be understood. Particularly, the putative influence of anthropomorphic similarity of visual aspect on social organization of avatars is a key issue to understand the cognitive processes used to form social interactions in virtual worlds. Using the highly popular massively multiplayer online role-playing game World of Warcraft as a model of socially-active virtual setting, we analyzed the social behavior of 11,649 avatars as a function of their visual aspect. Our results show that social structuring in virtual settings depends on proximity to human visual aspect. Social groups formed by human-like avatars display more homogeneity than what the optimal use of the interface would predict, while this effect is not observed for social groups formed by non-human avatars. Thus, immersion in virtual environments depends more on visually-triggered social dynamics (role-play) than on optimal use of the interface (game-play). Furthermore, social aspect may override the immediate reward of interface optimization, thus representing a major factor of immersion in virtual environments.

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## 1. Introduction

Virtual settings are more and more important in modern societies, and are used for numerous applications, ranging from recreational and educational to therapeutic (Bainbridge, 2007; Mayo, 2009; Murray-Rust, 2008; Rose, Brooks, & Rizzo, 2005). The development of virtual environments also provides new tools to investigate cognitive skills, such as memory, spatial cognition, or multimodal integration (Guitton, 2010; Kessler & Thomson, 2010; Newman et al., 2007). Progress in these areas is possible because virtual worlds are now reaching a level of realism sufficient to simulate efficiently some aspects of real environments (Bartle, 2003; Giard & Guitton, 2010; Lee et al., 2003).

One of the main characteristics of virtual environments is that they are inherently social spaces (Alexander, 2003; Bartle, 2003; Cole & Griffiths, 2007; Williams, Ducheneaut, Xiong, Yee, & Nickell, 2006). Indeed, through virtual self-representations called avatars, individuals can interact, bond, and create emotional relationships with other users (Bainbridge, 2007; Cole & Griffiths, 2007). The intensity of social contacts in virtual spaces often leads to the creation of transient to long-lasting social groups (Alexander, 2003; Cole & Griffiths, 2007; Guitton, 2010). The existence of these social interactions, and of the resulting social groups, is one of the

key factors of immersion in virtual environments (Bartle, 2003; Chen, Sun, & Hsieh, 2008).

However, the parameters which favor social structuring in virtual settings are still far to be understood (Bainbridge, 2007; Chen et al., 2008). Some studies have suggested that proximity to human standard visual aspect (anthropomorphic similarity) could play a role in the social aggregation of people in virtual settings (Kim, 2009; Nowak & Rauh, 2008; Taylor, 2002). The similarity principle also underlies an attraction between individuals who look similar (Bailenson, Garland, Iyengar, & Yee, 2006). Moreover, laboratory-setting studies suggested that a higher group identity and conformity could be reached when the avatars presented important visual similarity (Kim, 2009; Lee, 2004; Lee & Nass, 2002). Although, it is unclear whether this putative effect of proximity to human standard visual aspect on social aggregation can be generalized to long-lasting ecological cyber-environment. More important, it is unknown whether the visual aspect is a consequence or a trigger of social structuring. Furthermore, would the visual aspect be a factor stronger than others (such as avatar behavior within the game or interface optimal use) of avatars' social aggregation?

To investigate this lingering question, we selected as a model the highly popular massively multiplayer online role-playing game World of Warcraft (Blizzard Entertainment) (Bainbridge, 2007; Chan & Vorderer, 2006; Chen et al., 2008), which presented for us two particular characteristics of interest: first, the game dynamic requires the players to create autonomous social groups

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**Table 1**  
Description of the sample.

	Alliance	Horde	Total
Number of Guilds	40	40	80
Number of male avatars	3439	3757	7196
Number of female avatars	2788	1665	4453
Total number of avatars	6227	5422	11,649
Average size of the Guilds	155.67 ± 94.53	135.55 ± 60.32	145.61 ± 77.43
Minimum size of the Guilds	38	19	–
Maximum size of the Guilds	417	251	–

– the Guilds – to coordinate their actions (Chen et al., 2008); second, the two allegiances of the virtual world gather races with highly contrasted visual aspects: human-like aspect (the Alliance) vs. non-human, more exotic monster-like aspect (the Horde). We thus analyzed the social aggregation of 11,649 socially active human-like and non-human avatars. Our results clearly demonstrate that social structuring in virtual settings depends on proximity to human visual aspect. Thus, immersion in virtual environments depends more on visually-triggered social dynamics (role-play) than on optimal use of the interface (game-play).

## 2. Material and methods

### 2.1. Data collection

Information about socially-active Guilds and avatars was collected using the searchable database of the “World of Warcraft Armory” website ([www.wowarmory.com](http://www.wowarmory.com)), which provides information

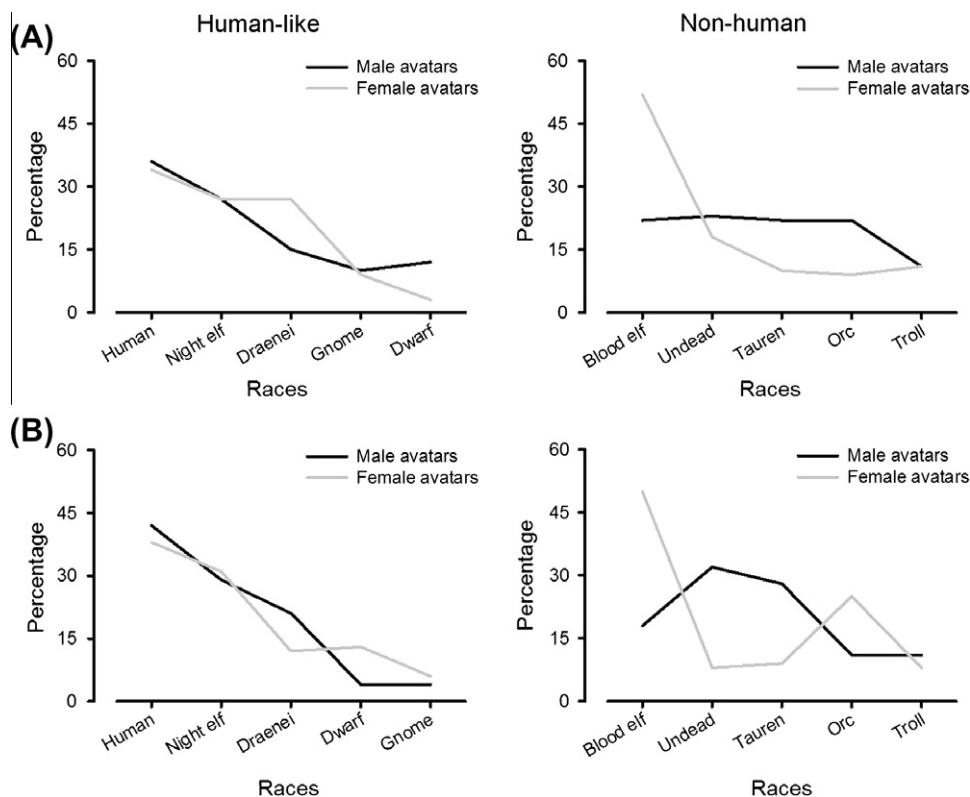
regarding avatars, their server and their group affiliation (Guitton, 2010). Socially-active Guilds were randomly selected from Guilds having members active in the website forum (Guitton, 2010). Groups were selected from North-American English-speaking servers, from December 2009 to February 2010. Eighty Guilds were chosen equally from the two allegiances of the virtual setting (40 human-like Alliance Guilds, and 40 non-human Horde Guilds). At the time of data collection, the Alliance gathered five human-like playable races: humans, dwarfs, gnomes, night elves, and draeneis. In contrast, the Horde gathered five non-human (either monster-like or over-fantasised versions of humans) playable races: orcs, trolls, taurens, undead, and blood elves. For each group, the leader’s in-game race and sex were recorded, as well as the exact constitution in terms of in-game race and sex of avatars composing the group.

### 2.2. Homogeneity indexes

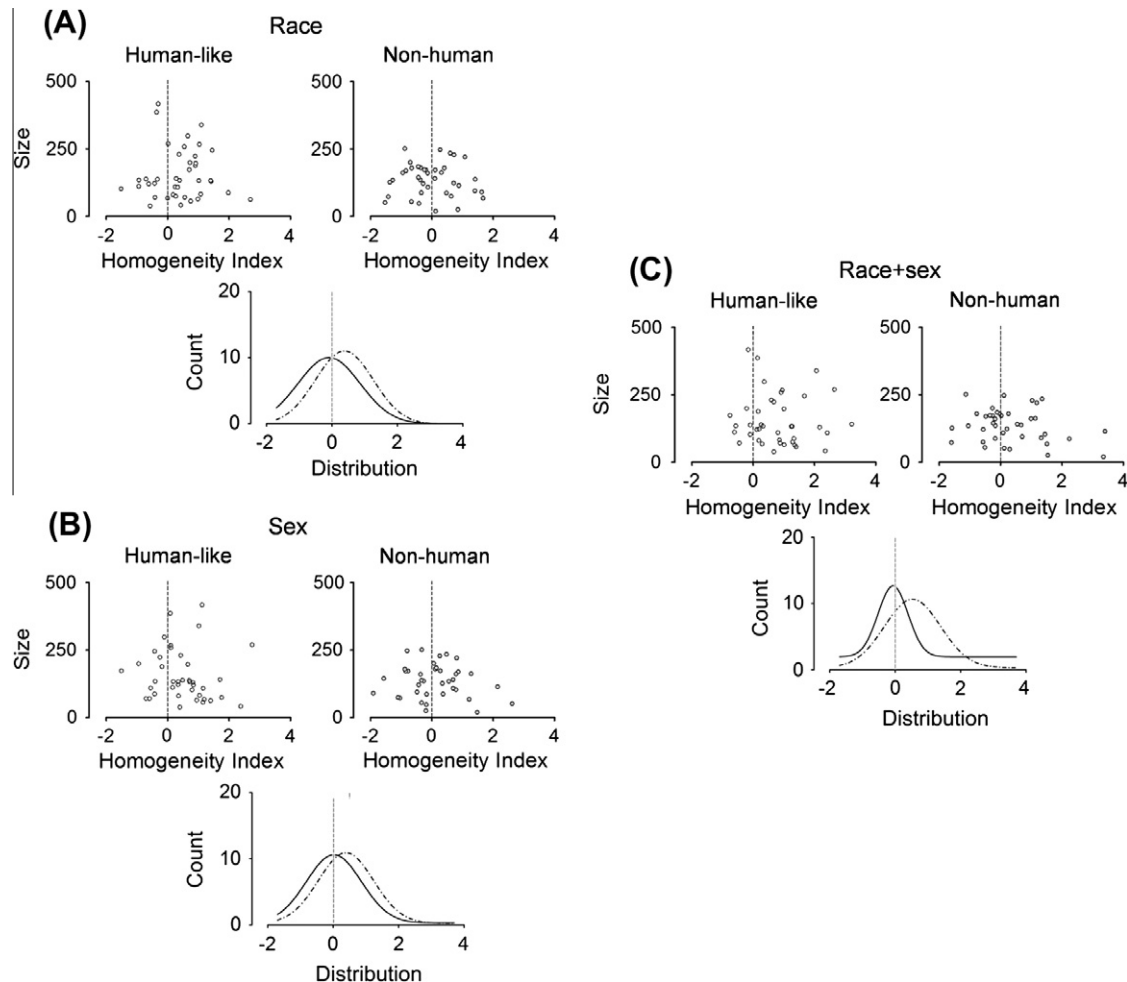
In each group, the relative homogeneity has been quantified as a function of the leader characteristics. Homogeneity indexes have been used as variables and computed for three parameters: the leader’s in-game race, in-game sex, and the combination of these two parameters. Homogeneity indexes have been calculated as the distance in standard deviations between the repartition of a given group and the average repartition of the actual parameter in groups of the same category. Positive values reflect a greater homogeneity than average on the concerned parameter than in groups of the same category.

### 2.3. Statistical analysis

Overall repartitions were analyzed using Chi-Square  $X^2$  test based on frequency counts. Statistical analyses on homogeneity indexes have been performed using non-parametric Mann–Whit-



**Fig. 1.** Avatars repartition in the groups analyzed. (A) Average repartitions of human-like and non-human avatars, in function of in-game races. A significant difference in overall repartition was observed between non-human male and female avatars ( $X^2$ ,  $p < 0.001$ ). (B) Repartition of human-like and non-human leaders, in function of in-game races. A significant difference in overall repartition was observed between non-human male and female avatars ( $X^2$ ,  $p < 0.001$ ). Black lines represent male avatars, white lines represent female avatars.



**Fig. 2.** Relative homogeneity of social groups as a function of avatars visual aspect. Relative homogeneity was assessed depending on three parameters: the in-game race of the leader (A), the in-game sex of the leader (B), and the combination of these two parameters (C). For each parameter, the upper graphs display the homogeneity indexes for each group analyzed, and the lower graphs show the distribution fit by Gaussian curves of human-like (dashed line) and non-human avatars (plain line). Positive values indicate greater homogeneity than expected.

ney U-test. Nonlinear Gaussian curve fits have been performed on frequency counts with bin size of 0.6. When applicable, results are presented as mean  $\pm$  SEM.

### 3. Results

Eighty groups, gathering a total of 11,649 avatars, were chosen equally from the two allegiances of the virtual setting. Forty human-like groups (for a total of 6227 avatars, 155.67  $\pm$  14.95 avatars per Guild, 3439 male (55.23%) and 2788 female avatars (44.77%)), and forty non-human groups (for a total of 5422 avatars, 135.55  $\pm$  9.54 avatars per Guild, 3757 male (69.29%) and 1665 female avatars (30.71%)) were randomly selected from having active members on the website's forum (Table 1).

While no significant difference was assessed across gender in overall race repartition for human-like avatars' groups ( $X^2 = 8.938$ , d.f. = 4,  $p = 0.063$ ), clear difference appeared for non-human avatars' groups ( $X^2 = 22.724$ , d.f. = 4,  $p < 0.001$ , Fig. 1a). The same happened in overall repartition of group leaders' races, with no significant difference observed across gender for human-like avatars ( $X^2 = 7.886$ , d.f. = 4,  $p = 0.096$ ) but a significant difference for non-human avatars ( $X^2 = 45.134$ , d.f. = 4,  $p < 0.001$ , Fig. 1b).

The groups' relative homogeneity was measured accordingly to three parameters: the group leader' in-game race, in-game sex, and the combination of these two parameters. For each of these three

parameters, a significant difference was assessed between groups of human-like and non-human avatars (Fig. 2). In each case, groups composed of human-like avatars presented a positive index of homogeneity ( $0.4 \pm 0.13$ ,  $0.48 \pm 0.14$ ,  $0.8 \pm 0.15$  for race, sex, and combination of the two, respectively, all different from non-human avatars ( $U = 585$ ,  $p = 0.039$ ;  $U = 565$ ,  $p = 0.024$ ; and  $U = 565.5$ ,  $p = 0.024$ ) and from 0, while non-human avatar groups presented no index of homogeneity different from 0 (Fig. 2).

### 4. Discussion

The results presented here shade a new light on our understanding of general cognitive strategies used by human beings to generate social interactions and behaviors in virtual settings. We demonstrate here that visual aspect may condition partially the future involvement of the avatar into social groups.

Early studies have proposed that sharing a similar avatar in a virtual setting may act as a basis for group formation, by signaling a belonging to a common category (Turner, 1984). Our results seem to indicate that this psychological phenomenon occurs only if the avatars have a reasonable degree of anthropomorphism. This idea is reinforced by the fact that the repartitions of non-human avatars varied much more than human-like ones, both for group's races and group leader's races. Thus, lesser proximity to human standard

visual aspect seems to trigger more variability. Alternatively, human visual aspect may act as a stabilizer in avatar aggregation. Interestingly, the races of non-human avatars responsible for this variability were not the same in groups and group leaders, clearly reinforcing this notion.

Surprising results emerged when looking at the fine organization of the groups. In the game setting of World of Warcraft, each race has different characteristics. Optimizing the game-play (i.e., interface' optimization to reach higher levels and get better items) requires to take advantage of the complementary aspects of different avatars, and thus, to form heterogeneous groups. Therefore, we did not expect to find positive indexes of homogeneity – reflecting greater homogeneity than average on the concerned parameter than in groups of the same category – in human-like groups. Furthermore, this phenomenon was not observed in non-human groups, therefore suggesting different structuring strategies depending on the visual aspect (human-like/not human) of the avatars. In World of Warcraft, the Guild leaders cannot only create game-oriented social groups (the Guilds), but they also can accept or reject candidates willing to join them (Chen et al., 2008; Yee, 2006). However, the appearance of the avatar clearly plays a role in this process, as it contributes to determine its future social gathering.

In the context of our study, one of the advantages of using the virtual World of Warcraft was that the visual aspect of the avatar (at least the fundamental features) is fixed once for all during the creation process (Williams et al., 2006). Despite the apparent freedom of the character creation process, virtual characters are not disconnected from the players, but may result from a combination of actual and idealized selves (Bessière, Seay, & Kiesler, 2007; McKenna & Bargh, 2000). In addition, it has recently been shown that visual aspect predates some of the elements of character creation (Guitton, 2010). Furthermore, at the time of data collection, the avatar race was one of the most important factors of the creation process, as it conditioned its class (in-game specialization of the avatar: e.g., warrior, hunter, warlock, ...). Thus, this particular setting represented an ideal model to enlighten interactions between visual aspect of the avatar and long-term social gathering behavior. Such an effect of visual aspect on social structuring may have been more difficult to evidence in virtual settings in which visual aspect of the avatar can be modified on demand, such as Second Life (Bainbridge, 2007). Even if different degrees of human-likeness exist within the Alliance and the Horde, this dichotomous segregation was very convenient to gather large enough samples to unveil this phenomenon.

Interestingly, qualitative studies suggested that distance from human aspect favored a distancing between the avatar and the human behind the avatar (Taylor, 2002). In other words, humans would immerse themselves less strongly into avatars displaying a non-human aspect. Our result may suggest that, indeed, proximity to standard human visual aspect may favor embodiment. In contrast, humans playing non-human avatars seem to be more interested into game-play (e.g., gaining levels in the game or particular items) than role-play (e.g., building complex social networks).

In conclusion, our results clearly demonstrate that, when being represented by a human-like avatar, people tend to gather – not necessarily consciously – with others who look the same than they do, even if such social behavior will impair their performances in the virtual environment. For avatars displaying human-like appearance, the visual aspect seems to prevail over both displayed behavior and interface optimization as the main factor triggering social structuring. Taken together, these results are critical not only to understand the cognitive basis of social behavior in virtual settings, but also to optimize the use and design of future immersive virtual environments.

## 5. Conflict of interest

None declared.

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